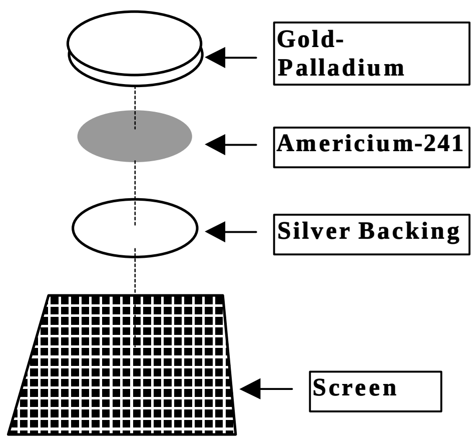
M43A1, CAM, and ACADA USER TRAINING

M43A1 Chemical Agent Detector

The M43A1 Chemical Agent Detector (CAD) contains 250 μCi of Am-241. The M43A1 Detector operates on the principle of molecular ion clustering. An air sample is drawn over the radiation source, which causes clustering of molecules with water and air. The air sample is drawn through a sensor cell, which is geometrically configured to allow passage only to clusters below a certain mass. The nerve agents cluster very rapidly whereas atmospheric agents do not. The molecules are impacted on a collector and an electrical signal is obtained when nerve agents are present.

The source is located in the cell module of the detector, it consists of a foil disc made of 250 μCi of Am-241 oxide in a gold matrix contained between a gold-palladium alloy face and a silver backing. The disc is affixed onto a metal screen, which is secured by a retaining ring within the sensing housing. This source is considered a “special form” source.



The Am-241 source has passed rigorous environmental and accident situations without damage or leakage and is expected to remain intact during normal operating conditions, throughout its life cycle. However, small amounts of radioactive contamination have been detected in some M43A1 Chemical Agent Detectors.

Constant bombardment from the alpha particles emitted by the Am-241 has caused the gold-palladium cover in some of the detector modules to deteriorate. This deterioration is in the form of small cracks similar to “heat checking”. In the most severe cases these cracks may penetrate the cover allowing moisture from the air to contact the Americium oxide causing it to plate out onto the outer surface of the cover. Continued use of the device will cause this contamination to migrate through the air path. The contamination is in the form of a powder found in the plastic tubing between the pump module and the cell module.

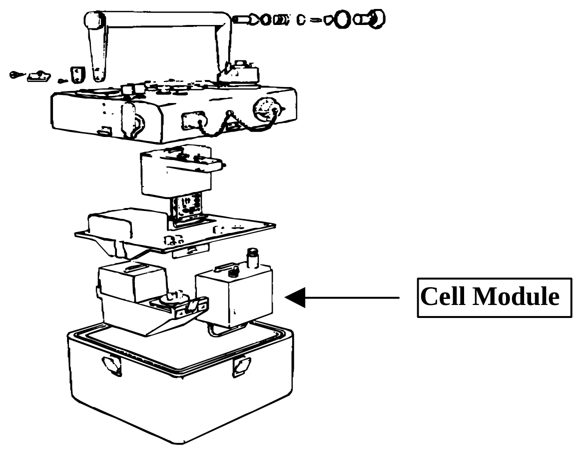
Owners and maintenance personnel of this equipment have been alerted to take the following actions:

1. Ensure all users are reminded that use of the 0.2 micron exit port air filter is mandatory when the M43A1 is used indoors.
2. Ensure strict adherence to the procedures in the technical manuals regarding wearing gloves, use of Kraft paper on the work bench, and monitoring the area with an alpha meter when maintenance is being performed.

3. If you see any white powder, moisture or gold flakes in the pump tubing immediately place the device in double bags, seal and tag the bag then immediately contact your local RSO.

DO NOT PERFORM ANY MAINTENANCE ON THE DEVICE.

Immediately contact your installation RSO for further instructions.



Biological Effects Of Americium-241

The M43A1 contains Americium-241. Americium-241 primarily emits alpha and gamma radiation. The gamma radiation energy is very low, so an external dose could not be received unless large amounts of Am-241 are stored in one area and a person is in close contact with the material for most of the work day.

The high-energy alpha emission can present an **internal** radiation hazard if it is ingested. Am-241 is chemically analogous to calcium and can replace calcium in the body, especially in bone material. For this reason it is often referred to as a “bone seeker”. Once incorporated in the bone, the bone and surrounding tissue are constantly irradiated, which may potentially result in leukemia and malignancies.

Since Am-241 primarily emits alpha radiation, alpha detection equipment must be used to accurately assess contamination levels. A Thermoluminescent Dosimeter (TLD) used to measure external radiation exposure, is not required for use of the M43A1.

Chemical Agent Monitor

Ground forces use the CAM to search and locate chemical agent contamination on personnel, equipment, ship's structures, aircraft and land vehicles, buildings and terrain. The CAM responds to nerve and blister agent vapors down to the lowest concentrations that could affect personnel over a short period.

The principle of detection is based on ion mobility spectrometry. Outside air is drawn in through the sampling probe across the membrane. Air molecules are swept over the membrane and permeate into the detector cell where the air molecules are ionized by the Ni-63 source as they pass through the drift tube module. The molecular ions are propelled through the drift tube module by their attraction to the shutter grid. An electrostatic field is established around the drift tube by applying a 1000 volt DC potential to the space rings. The polarity of the applied voltage is such that ions are repelled from the wall of the tube and remain suspended in flight until they impact upon the faraday plate. When ions from organic vapors are present and are collected at this plate there is an exchange of charge and a change in current is detected. The current is averaged and displayed on the LED readout. The LED indicates the relative concentrations of agent or simulator present.

Automatic Chemical Agent Detector Alarm (ACADA)

The Automatic Chemical Agent Detector Alarm (ACADA) is a nerve and blister chemical agent detector that contains radioactive material. As such, its use, control, storage, handling, transportation and disposal are set forth in a license issued by the Nuclear Regulatory Commission (NRC) to U.S. Army Soldier and Biological Chemical Command (SBCCOM). The ACADA is a relatively new item to the Army, and is similar in function and identical in radiological requirements as the currently fielded Chemical Agent Monitor (CAM). The M88 Chemical Agent Detector Unit is the only component in the M22 (the ACADA) that requires radiation leak testing.

The ACADA contains a total of 20 millicuries of Nickel-63 (Ni-63). Ni-63 emits beta radiation with a maximum energy of 67 keV, and a half-life of 100 years. The long half-life and low energy beta make it an ideal source of beta radiation, as the low energy does not create a significant radiation hazard to the user. This low energy however, makes Ni-63 difficult to detect in an accident scenario.

Biological Effects Of Nickel-63

Ni-63 sources used by the military are not a biological hazard as long as they remain sealed. With a radiological half-life of 96 years, Ni-63 is a beta emitter with a short decay chain and no gamma radiation. The beta energy level of Ni-63 is too low to penetrate the dead layers of skin therefore it is considered to be an internal hazard. The amount of Ni-63 intake determines how much biological hazard exists. Efforts should be taken to prevent ingestion, inhalation, or absorption through broken skin. Released Ni-63 may cause contamination of personnel, personnel clothing, work areas, and the air. Treating Ni-63 sources with special care, and ensuring they are not damaged is the best protection against contamination or exposure. **Intact sources of Nickel-63 are not hazardous.**

SAFETY CARE AND HANDLING (M43A1, CAM, ACADA):

The sources are fully enclosed and protected in the M43A1, CAM and ACADA cases. There is no danger of radiation or contamination as long as the housings are not damaged. The M43A1, CAM and ACADA are potentially dangerous if the housings are broken. Handle carefully!

STORAGE (M43A1, CAM, ACADA):

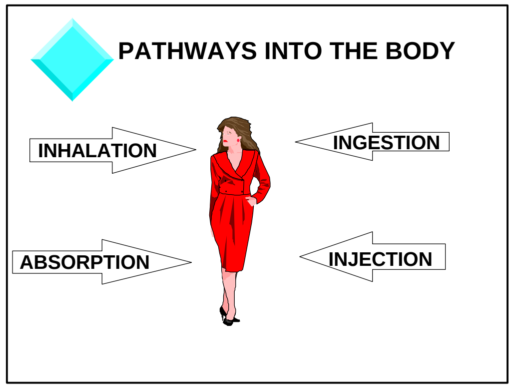
User storage areas will be secured against unauthorized access. The storage areas will be located free from the dangers of flooding and outside the danger radius of explosives and flammables. Storage requirements are no different than those for any other radioactive material. They must be stored in a secure area, where unauthorized persons cannot get to the radioactive material. "Caution-Radioactive Material" sign(s), the Public Law, and NRC Form 3 must be posted wherever these are stored. In addition, other postings required are 10 CFR parts 19, 20, 21; the SOP; No eating, drinking, etc. sign; and the NRC license.

Exposure Control and Dose Reduction.

Once radioactive material has entered the body, there is no practicable method to reduce the internal exposure or the resultant dose. Some examples of reduction methods are increased liquid intake and bone marrow transplants. If the radioactive material has a long half-life, it may continue to irradiate the exposed person for the rest of the person's life. Because of these difficulties, the intake of radioactive materials should be prevented.

Radioactive material can be taken into the body by one of the following methods.

- Ingestion
- Inhalation
- Absorption
- Injection



The major pathways are **ingestion** and **inhalation**. Once in the body, these materials may be deposited in various organs and constitute a source of internal exposure, until they are excreted from the body by one of the following processes.

- Urine and Feces
- Exhalation
- Perspiration

Considerable effort should be expended to prevent any intake of radioactive material through accidental ingestion, inhalation or absorption. Reduction methods include:

Contain the radiation source.

Limit or reduce surface contamination.
What is radioactive contamination? Contamination is radioactive material in places where it is not wanted. Removable surface contamination is readily removed from the non-porous surface by wiping or dissolution with solvents or detergents. Removable surface contamination could present both an internal or external hazard depending on the type of radiation present. If the contamination is ingested, by contaminated hands, inhaled by breathing dust from surface, or injected by a contaminated projectile, it is an internal hazard.
What is decontamination? Removal of the radioactive material from places where it is not wanted.
Fixed surface contamination, which is not easily removed, presents an external hazard only.

RADIOACTIVE CONTAMINATION

Radioactive material in any place where it is not desired

DECONTAMINATION

Removal of radioactive material from an undesired place

Reduce airborne contamination.

Gases, dust and vapors released from radiation sources can become airborne and be inhaled by persons in the area. Methods used to limit airborne contamination include:

(a) Proper ventilation of the work place. Proper ventilation will prevent the buildup of radioactive dust, vapors and gases in the air and reduce the amount breathed by workers in the area.
(b) Reduction in surface contamination. Timely surveys for removable contamination, and prompt removal of contamination will reduce the amount that could become airborne, and or be ingested.

Use of protective equipment.

Use of gloves will prevent absorption through the skin. Use of absorbent material covering the work place will better control the contamination. Use of shoe covers will prevent spreading the contamination.

Administrative guidelines.

These guidelines control the actions and access to areas that may become contaminated. Prohibition of eating, drinking, smoking, chewing gum or tobacco, and applying cosmetics are also steps that may be used to reduce airborne concentrations and internal exposures.

RADIOLOGICAL EMERGENCIES.

a. *General*. Plans and procedures should be developed for the potential situations that could occur. When using military radioactive commodities, the situations most likely to occur are loss or breakage of a commodity. Of the two, breakage that results in contamination of personnel and areas is most likely.

b. *General Procedures for Damaged Devices.*

If a device shows indications of being damaged or you suspect contamination is present you should:

(1) Isolate the area
(2) Wear gloves and shoe covers
(3) Bag and Tag the item
(4) Contact your RSO
(5) Track your actions

c. *Procedures for Loss of a Radioactive Commodity.*

(1) Contact the RSO
(2) Make a physical search of all areas where the calibrator could have been used or stored.
(3) Follow instructions provided by the RSO.

NOTE:

Each loss of a CAM, CAD, or ACADA is reportable to the NRC under 10 CFR 20.2201(a)(i). All losses or suspected losses shall be reported to the SBCCOM Safety Office as soon as the loss is discovered.

U.S. Army Soldier and Biological Chemical Command
ATTN: AMSSB-RCB-RS (Joyce Kuykendall)
E5183 Blackhawk Road
Aberdeen Proving Ground MD 21010-5424
DSN: 584-7118, Commercial: (410) 436-7118

TRAINING SIGN-IN SHEET

(Provide Copy to State Radiation Safety Officer)

TOPIC: M43A1, CAM, ACADA User Training
LOCATION and DATE: ______________________________

PURPOSE/DESCRIPTION: Provide user training for the M43A1, CAM and ACADA.. Subjects include: Safe Handling Procedures, Biological Effects of Exposure to Radiation and Emergencies Procedures

GIVEN BY: ______________________________

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